# Quadripartite Advisory Publication

**(QAP)**

**Number 230 Edition 1**

**ESSENTIAL INFORMATION PATHS WITHIN AND BETWEEN COALITION FORCES THAT ARE REQUIRED FOR EFFECTIVE OPERATIONS**

# DECLARATION OF ACCORD

1. Introduction:

The information contained in this Quadripartite Advisory Publication (QAP) introduces those areas of a specialized nature where standardization is premature but the identification and exchange of which achieves substantial gains in mutual understanding and cooperation.

2. Scope:

This document lists, describes and portrays essential information paths within and between coalition forces that are required for effective operations.

3. Continuity and Related Agreements:

This QAP was developed as a result of the work of SWP BaD (Battlefield Digitization) under the auspices of QWG AOR. The United States is the Custodian Army.

4. Amendment:

The contents of this QAP should be revised as appropriate by contributing Armies to reflect developments in national practices and to maintain its currency.

5. Use:

The information contained in this QAP should, wherever possible, be used by Armies to improve the level of standardization in the area of battlefield digitization.

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# ESSENTIAL INFORMATION PATHS WITHIN AND BETWEEN COALITION FORCES THAT ARE REQUIRED FOR EFFECTIVE OPERATIONS

***Quadripartite Advisory Publication (QAP)***
***Of the***
***Quadripartite -Working Group on Army Operational Research (QWG/AOR) Special Working Party on Battlefield Digitization (SWP/BaD)***

**December 1998**

## 1. PURPOSE

The purpose of this QAP is to present recommendations on digitization of information paths in a coalition force. This QAP consists of an introduction, a main section which presents the major findings, a glossary, a section describing an experiment carried out to investigate digitization (Exercise Broad Paws), and sections containing inputs from each of the ABCA nations. This QAP should be considered a first attempt at identifying and prioritizing information paths in a coalition force, and future editions of this QAP are anticipated.

## 2. INTRODUCTION

### Information Paths

Information paths are defined as the personnel, equipment, and interconnections that facilitate the transmission of information from one point to another. Voice communications are among the most common forms of communications among coalition forces. These conversations are usually carried by means of radios. Military users often prefer voice communications because it is faster and provides an intangible element (clues to emotional state) that does not come with other means of communications. Other forms of communications can support text and graphic representations. Text, drawings, maps, overlays, and photographs are examples of such communications. Historically, such graphics were distributed only by actual movement of physical media from one place to another. Recently, facsimile and digital representations of graphics have revolutionized the storage and transport of text and graphics.

The paths over which the information traverses have traditionally been up and down “stovepipe” or vertical[1] communications links. Much of the information which will be passed on the battlefield of the future will continue to be passed this way due to the requirement that commanders need to give orders to their subordinates and pass information which is of interest to the units above or below. In a stable situation with plenty of time to pass information or requests for information to another headquarters, have it analyzed, and sent to those appropriate, this kind of information

[1] See Glossary

flow works well. Problems arise when there is a fluid situation with rapidly changing boundaries and there is less time for much of the information to flow up and down the “stovepipe”. This fluid situation is the most likely environment in which the next war will be fought. In such a situation, lateral flow of information may be as important as vertical flow.

Driven by the need to disperse for survivability, the distances between elements needing to communicate have been increasing, lengthening the information paths. At the same time, graphics-intensive applications require more and more information to be passed. The challenge of modern communications is that along with advances in technology that allow more distant communications, there are also growing problems in establishing reliable communications. Among these problems are the increasing amount of information which is passed over the links, the efforts by the enemy to disrupt or exploit communications, and self-jamming of radio links in the form of cosite interference.

Computers are proliferating throughout the armies of coalition forces. These computers are bringing more powerful information storage, processing, and communications capabilities to every staff element. Some computers hold information on locations and dispositions of friendly forces. Other computers receive intelligence information from sources that range from lower level units to national collection assets. Still other computers track the status of everything from the number of rounds of ammunition to the health of the troops. The challenge for a coalition force is to harness the diverse capabilities of these computers and the information they contain to maximize the effectiveness of the force. Thus the study of information paths among elements of the coalition is critical.

## Methods of Studying Information Paths

Information paths have been studied in the ABCA Armies with experiments ranging from live events involving troops in the field to constructive simulations with no human intervention. The US Advanced Warfighting Experiment (AWE) Task Force XXI was a live simulation and ABCA Broad Paws exercise was a manned simulation driven by a wargame (Janus) that sought both to study and to understand information paths. Constructive simulations used in studying information paths include such tools as OPNET, CASTFOREM, DICE, Adam, etc.

This QAP is a summary of the work done to date in determining which information paths in a coalition force would provide the greatest benefit from digitization. The battlefield digitization findings and recommendations summarized here involved echelons brigade and below. Findings and recommendations relating to coalition forces were especially sought out. Other findings and recommendations that are not directly related to coalition forces were included if they were not limited to any one nation.

The findings and recommendations here were derived by distilling information from a wide variety of sources. Subject matter experts (SMEs) observed staffs working in both conventional and digitized environments, analysts examined data collected from voice recordings and network taps, modelers studied wargame and simulation outputs, and conducted interviews with staff members after both national and coalition exercises. Additionally, numerous documents containing analyses

of information flows, lessons learned about digitization, and results of past exercises were reviewed for insights. (See references in each national submission, Annexes C to F)

## 3. FINDINGS AND RECOMMENDATIONS

The findings and recommendations presented in this section are organized into the following categories: Doctrine and Tactics, Techniques, and Procedures (TTP); Training; Leader Development; Organization; Materiel; and General. This section concludes with a summary of the current recommended prioritization of information flows.

**Doctrine and TTP Findings**

One of the most useful applications of digitization is to give every user a common picture of the battlefield. The locations of all friendly units in the common picture should be automatically updated at each staff element. This eliminates one of the most frequent messages sent over voice nets: request for the current location of a unit. Enemy unit locations should be consolidated by the intelligence element and passed to all the users as an overlay to the common picture. This will reduce the second most common voice message, the spot or contact report. Digital information is useful only if it can be digested and displayed in a form that is intelligible to the commander. When information is passed digitally, it is most useful if it can be displayed graphically, either on a map, or on a chart shown in relationship to other data.

Tactical information should be stored in multiple redundant databases at every command echelon to ensure survivability of the data and access to information during communications outages.

At our present state of knowledge concerning information needs, we cannot predict the information a commander and staff will need. Therefore, all information should be available to all commanders and staff elements, ideally by means of a smart push/pull information management system, with the capability for the users to filter the information as required.

Voice and data communications need to be separated to avoid data/voice contention on the communications networks. In those cases where voice and data must coexist on the same network, systems must be designed to establish synergy between voice and data.

Priority must be given to maintenance and management of digitized networks.

US AWEs indicate that changes in TTP are necessary to capitalize on the benefits provided by digitization.

Items such as orders are very structured and should be amenable to automated assistance in their writing, distribution, and duplication. Reports and other pre-formatted messages must be user friendly and simple enough that the users will use them.

The command and control system must be able to satisfy the commander’s critical information requirements (CCIR). The commander decides what information makes up the CCIR based on its ability to answer questions about friendly and enemy capabilities and intent. This requirement is

defined as information that directly affects the successful execution of operational or tactical operations. It is further characterized as--

- Situationally dependent, predictable information.
- Specified by the commander for each separate operation or implicitly recognized by the staff as such based on the understanding of the commander's mission and intent.
- Generally time-sensitive in terms of formalizing decisions at specific decision points.
- Applicable only to the commander who specifies it.
- Normally published in an OPORD or OPLAN to subordinates with the requirement that both staff and subordinates report receipt of the information to him.
- Normally transmitted over predetermined channels specified in the SOP or directly accessed by the commander via face-to-face communication with subordinate commanders, staffs, and units.
- A link between current and future operations.

**Training Findings**

The armies must address the adequacy of the troops' training in combat fundamentals and the adequacy of current training in applications/systems/functions that make use of digital technology for troops and leaders. The soldiers and their leaders must be properly trained in the technological and multi-functional literacy skills needed to operate and support digital equipment in an optimum fashion. These requirements also imply sustained training, as training in digitized technologies has been observed to be very perishable.

Information-age technology not only increases digital competence requirements for leaders and troops, but it also requires a large number of experts and a diversity of expertise to keep all systems operating and secure.

**Leader Development Findings**

Information proliferation on the battlefield complicates the decision making process. Staffs must be able to absorb and condense large amounts of information in order to allow commanders to make timely tactical decisions. Commanders must break the habit of fixating on "raw" information from sensors and must wait for the staff to complete their analysis of available data to get a truer picture of the real situation. Australian and US exercises have demonstrated that commanders tend to focus on "own" forces locations and status during times of intense combat and also to become fixated on a single source of threat data (such as unmanned air vehicle (UAV)) during periods prior to combat. Decision support and information filtering tools may be able to help the commander and staff "see the battlefield" more accurately.

**Organization Findings**

The assertion that digitization will allow reduction of force structure warrants further investigation, as US AWE results indicate that a reorganization of force structure is probably more appropriate than a reduction of force structure.

**Materiel Findings**

It is a waste of effort to input information that will not be used or to input information more than once. If the user is required to enter information (especially locations) he will be less likely to use the system in the middle of a battle. Embedded systems that take inputs from GPS receivers and sensors of combat systems will make many such user inputs unnecessary and vastly increase the utility of the system.

Most currently available computer technologies and applications are too complex for stressed, time-pressured, and infrequent users. Lack of user-friendliness and poor soldier-machine interfaces discourage use of the information technology in stressful situations.

The volume of information that must be transmitted to accomplish the goal of a common picture of the battlefield is beyond the capability of most current radio communications systems. Those few communications systems that can handle this high volume are already overloaded with messages from higher echelons. This communication shortfall can be attacked by increasing the size and number of the communications pipes or by limiting the amount of information passed (using smart updates, etc.).

Communications on the move is still a problem. Even though units can communicate by voice on the move, there is so much stored digital information that a mobile digital communication capability is very desirable.

Ability to interface electronically does not equate to compatibility. Two systems may be able to exchange messages, but unless the contents of those messages are automatically translated into forms that can be used (stored, displayed, plotted) by both systems, they have not reached true compatibility.

Digital information systems need more functionality, increased user friendliness, vertical and horizontal linkages, bandwidth, and to be integrated with non-digitized systems.

There is a serious lack of connectivity, both vertical and horizontal, and of integration among and between digital systems currently on the battlefield. The lack of connectivity between digitized units and non-digitized units requires ad-hoc personnel-intensive procedures to ensure collection, processing, and dissemination of information. Thus there is a large increase in the requirement for "Swivel-chair" interfaces (liaison) between systems.

Digital Command and Control (C2) suffers from a lack of automated planning tools (including digital maps) and of wargaming simulation capabilities (for course of action analysis, decision aids, mission rehearsal).

The Armies must achieve commonality, standardization, or at the very least (seamless) connectivity among their information systems.

Digitized maps for all areas of the world are needed.

**General Findings**

Digitization can facilitate access to a timely and accurate situational picture improving the commander's ability to formulate situational awareness and see the battlefield. E-mail communications significantly contribute to enhanced battle command. Forces are better able to synchronize their movements to mutually support each other when supported by digitized communications and staff assistance systems. This synchronization can increase force effectiveness by increasing lethality, survivability, and tempo.

To meet users' needs, any system must provide user-friendly message formats, assistance in preparation of plans and orders, and synchronization (horizontal integration) with other battlefield functional areas.

Expect moderate force performance increases from digitization. The US Army found after multiple AWEs, that digitization will not result in twofold or threefold increases in performance and/or effectiveness, except in isolated instances. On the average, increases in overall force effectiveness have been more modest. As such, military leaders and decision makers should be made aware that the potential enhancements afforded by digitization are more likely to be in the 20%- 40 % range, with the caveat that this only happens if the advantages of digitization are properly exploited. The improvement may be more significant once digitization has been more fully assimilated into the military culture.

The digitization impacts on performance and effectiveness for specific points in the battle or for specific platforms are extremely hard to isolate. The digitization impacts seem to be cumulative (over the whole force during the whole battle) and synergistic (improving the way platforms and units work together). In digitization AWE conducted by the US Army to date, analysis of final results almost always showed some increase in performance and/or effectiveness of the forces. The observed effects, however, are always cumulative and synergistic in nature, and it is usually not possible to isolate any single factor that, alone, contributed to the observed effects. Thus, there is no conclusive evidence that increased performance and effectiveness can be attributed to digitization alone. Also, US AWEs and other field exercises frequently do not show any force effectiveness benefit to digitization.

Commanders sometimes spend a significant amount of time trying to interpret what they see on their digital device screen rather than using their senses to command and control. In addition, it is usually found that proliferation of information increases staff workload substantially. The conclusion is that inefficient digital systems, their inefficient usage, and inadequate TTP or poor mastering of existing TTP can cause the digital systems to become distracters rather than helpers. If the message completion rate is low, the users will lose confidence in the system and abandon it in favor of voice communications. This results in wasted time and in lost opportunities to exploit the advantages of digitization and to dominate the battlefield.

Having information available does not ensure the success of any military endeavor. The US AWEs showed that if commanders and their staffs are not prepared to act on information available through modern means, they can still surrender the initiative and lose the benefit of having more than sufficient information.

Printed material, paper maps, and acetate overlays are still used extensively by commander and staff for personal and collaborative purposes, even though large screen displays are available and can facilitate improved SA. It appears that optimization of digital technologies will not change this trend and that the idea of a "paperless" tactical operations center (TOC) must be discarded.

Voice communication remains the preferred channel of communication during combat or during stressful situations. Under stress, soldiers become quickly frustrated with digitization equipment that is slow or cumbersome and abandon them in favor of voice radio, which they feel can get the job done more quickly. This leads to the conclusion that voice communications will not disappear from digitized units in the near future.

Expect digital message traffic to increase as people and units become more familiar with the digital equipment. This is a result of increased confidence in using the digital equipment.

In the US experience, digital C2 systems were not observed to decrease planning cycles, even though they allow for faster dissemination of information. Australian experience has shown reduced planning cycles if planning assistant tools are provided.

The question persists as to who will be responsible for providing the experts and expertise to keep digital systems operating. Should the Army increase the number of signal officers to fill those roles? Is a contractor corps the way of the future?

Digitization can allow users to insert and extract data from messages to update tactical databases. The information is envisioned as being stored at various locations, but accessible by any user, much like the information on the Internet. In this vision of the future, the information paths cannot be predicted in advance. In fact, paths to the information exist wherever there is a source of information and a user who wants to access the information.

One of the problems that need to be addressed is that of sharing digital information with units that have no digitization or incompatible digitization. TTP for digitized and partially digitized operations are inadequate. TTP for digital operations and for integration of non-digitized forces together with digitized forces need be revised and/or developed. This problem is exacerbated in a coalition force whose members have incompatible digitization systems.

Situational awareness is not currently provided with sufficient reliability or accuracy to be useful in avoiding fratricide. Observers at the US AWEs report that in order to achieve tactical surprise and reduce fratricide, situation awareness must incorporate all friendly elements within a unit's area of influence. What is the "area of influence" of a particular unit under digitized operations? How much SA is required to make a noticeable, positive, impact? Is absolute SA required? Is the commonly assumed rule of thumb "two echelons up and two echelons down" adequate? This needs more clarification.

There is currently no handle on the question of who should get what. In other words, no one has figured out yet what "the" appropriate distribution and allocation scheme for digital equipment and information should be. Further studies are needed.

Some of the items most often asked for by staff members are:

Timely responses to the staff's requests for information;

Ability to pass pre-formatted messages and data (to automatically update database);

Timely and easy-to-use software tools for orders preparation and visualization tools for command briefings and battle tracking; and

Ability to accomplish mission essential tasks faster using pre-formatted messages

**Priority of Information Flows**

1. All the studies examined to date (see above and annexes C to F) indicate that digital information flows that concern maneuver are most important. These information flows include the ones required to generate and process the location of friendly forces. This information is known as situational awareness (SA). US work and Exercise Broad Paws found reporting on the location of friendly forces to be of paramount importance. Information concerning enemy locations was slightly less important than friendly force locations. At this point, it appears that the number one priority for coalition digitization should be the information paths that control the perceived situation. Reports from exercises in Australia have highlighted that location knowledge of friendly and of enemy forces is of equal importance. Information paths that control the perceived situation are all you can achieve. It is very difficult to rank the significance of information paths since it depends on many variables and more importantly scenario (situation).

2. UK studies found that digitized information flow of fire support information is of great importance. Depending on the situation, fire support information can be as important as maneuver information flow. The fire support related information paths should be prioritized equal to or slightly below the SA related ones.

3. Preliminary information from the US AWEs indicates that during non-battle phases of tactical operations, information flows supporting combat service support (CSS) and intelligence, surveillance, and reconnaissance assume paramount importance.

# Annex A

## Glossary

| Term | Definition |
|---|---|
| ABCA | American, British, Canadian, Australian |
| ABCS | Army Battle Command System (US) |
| ADAM | UK model. For more information, contact Gordon Pattison at Fort Halstead |
| ATCCS | Army Tactical Command and Control System (US) |
| AWE | Advanced Warfighting Experiment (US) |
| Battlefield digitization | Application of computer technology to military command and control with the aim of increasing the efficiency of the military force |
| BCSS | Battlefield Command Support System (Australia) |
| BDE, bde | Brigade |
| BOS | Battlefield Operating System(s) |
| Broad Paws | An ABCA exercise carried out during March1998 to explore the advantages of digitization of various functional areas in a coalition force |
| C2 | Command and Control |
| C3 | Command, Control, and Communications |
| C4I | Command, Control, Communications, Computers and Intelligence |
| C4ISR | Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance |
| CASTFOREM | Combined Arms and Support Task Force Evaluation Model, a US analytical computer simulation (POC Roy Reynolds, Director, TRAC-WSMR, ATTN: ATRC-W, WSMR, NM 88002, USA, phone 505-678-4512, fax 505-678-6887, reynoldr@trac.wsmr.army.mil) |

| | |
|---|---|
| Cdr | Commander |
| CAEN | Close Action Environment (UK Wargame) |
| COA | Course of Action |
| Command | The authority vested in an individual of the armed forces for the direction, coordination, and control of military forces. (US JCS Pub 1.) |
| Command and control | The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through and arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. |
| Command and control system | The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing and controlling operations of assigned forces pursuant to the missions assigned. |
| Control | Authority which may be less than full command exercised by a commander over part of the activities of subordinate or other organizations. |
| CSS | Combat Service Support |
| DAWE | Division Advanced Warfighting Experiment (US) |
| DICE | Distributed Interactive C3I Effectiveness (Australian model, for more information contact Dr. Paul Gaertner, DSTO Land, phone 61 8 8259 7377, fax 61 8 8259 5624, e-mail paul.gaertner@dsto.defence.gov.au) |
| DTLOMS | Doctrine, Training, Leader Development, Organizations, Materiel, and Soldiers |
| e-mail | Electronic Mail |
| FBCB2 | Force XXI Battle Command, Brigade And Below. This computer system forms the cornerstone of brigade battlefield digitization in the US Army. |

| | |
|---|---|
| GPS | Global Positioning System |
| HHDT | Hand Held Data Terminal (Australia) |
| Information paths | The personnel, equipment, and interconnections that facilitate the transmission of information from one point to another |
| Janus | Wargame developed and used at TRAC-WSMR, USA, often used as an exercise driver |
| JV | Joint Venture (US Program) |
| LAN | Local Area Network |
| NTC | National Training Center (California, USA) |
| OPFOR | Opposing Forces |
| OPNET | Optimized Network Engineering Tool, a US communications network simulation (POC: Marc Cohen, Director of Marketing, MIL 3, Inc., 3400 International Drive, N.W., Washington, DC 20008, USA, phone 202-364-8390, Fax 202-364-8554, mcohen@mil3.com) |
| QAP | Quadripartite Advisory Publication |
| QWG/AOR | Quadripartite Working Group on Army Operational Research |
| RTA | Restructuring the Army (Australian initiative) |
| SA | Situational Awareness |
| SITREP | Situation Report |
| SME | Subject Matter Expert |
| Stovepipe communications | Communications between units and their subordinates and superiors. Also vertical communications. |
| SWP/BaD | Special Working Party on Battlefield Digitization |
| Task Force XXI | A project by the US Army aimed at demonstrating advantages of digitization in tomorrow's Army |

| | |
|---|---|
| TF | Task Force |
| TOC | Tactical Operations Center |
| TRAC | US Army Training and Doctrine Command Analysis Center |
| TRAC-WSMR | US Army Training and Doctrine Command Analysis Center at White Sands Missile Range |
| TTP | Tactics, Techniques And Procedures |
| US | United States of America |
| Vertical communications | Communications between units and their subordinates and superiors. Also stovepipe communications. |
| VTC | Video Teleconference |

**Annex B**

Please see:
American British Canadian Australian
Armies Standardization Program
Report on Potential Effects of Digitization
(Exercise Broad Paws)

**Annex C**

**US National Input**

# ***Impact of Digitization on Performance and Effectiveness in FORCE XXI.***

## I. Introduction.

The following report summarizes the results of an extensive literature search of publications related to recent Joint Venture Advanced Warfighting Experiments (AWE) that were conducted in an attempt to answer questions and issues pertaining to the effects of digitization on the battlefield. Numerous reports, briefings, items of correspondence, and other miscellaneous documents were examined with the goal of finding insights into the potential benefits that can be achieved by digitizing US Army units.

Documentation reporting on the following AWE was considered in this study :

- The Desert Hammer VI AWE (1993)
- The Battle Command AWE (1994)
- The Prairie Warrior/Mobile Strike Force Battle Command Experiment (1995)
- The Focused Dispatch AWE (1994-95)
- The Warrior Focus AWE (1996)
- The Task Force XXI AWE (1995-1997)
- The Division XXI AWE (1997)

For presentation purposes, the results of this survey are organized in three parts. Part one summarizes significant digitization successes, shortcomings, and implications for the future. Part two concentrates on experimental lessons learned, and part three lists issues and challenges that were not adequately addressed in this series of AWE.

In this overarching review, no attempt has been made to document which conclusion(s) came from which particular AWE because findings were remarkably consistent across all AWEs. Major AWEs like Task Force XXI or Division XXI were major contributors, and since these two events were also the most recent of the series, many of the conclusions reported here are based on findings from these events.

Finally, the reader should keep in mind that, when pertaining to the state of maturity of digital systems, only the most current findings are reported. This means that, if a conclusion from a later experiment seemed to contradict what was found in a previous experiment **and** there was a logical explanation for that change (e.g., a new software release fixed problems noted in a previous AWE), the later conclusion was usually kept.

## II. Successes, Shortcomings, and Implications.

### A) Successes :

- Digitization made timely and accurate Situational Awareness (SA) readily available to the commander.
- SA showed great potential for battle tracking, though only limited potential to reduce fratricide.
- Commanders and leaders were most successful in using digitization for self-location and tracking of subordinates. Tracking of units two echelons above and below were achieved.
- Digitization provided an improved intelligence picture.
- Digitization provided links to national/theater intelligence assets (e.g., GUARDRAIL, JSTARS) and to other high-payoff sensors (UAV, Comanche, Raptor).
- Digitized systems improved planning and coordination at the division level.
- In the Division AWE (DAWE), Army Battle Command System (ABCS) demonstrated potential for complete SA of own/enemy.
- Free text messages (i.e., email-type) were used extensively for command and control purposes. In fact, electronic messaging was the most widely used and most reliable type of digital application across all AWEs. Email communications significantly contributed to enhanced battle command.
- Digitization consistently resulted in increased weapon systems lethality and survivability.
- Overall, the performance of digitized units was at least as good as that of non-digitized units. (This is deemed a success because one could assume they could have performed worse due to all the new initiatives serving as distracters.)
- Modeling and simulation have demonstrated that, when proper connectivity is achieved, and when training constraints of the AWE process are removed, digitization has great potential to enhance force performance and effectiveness.

### B) Shortcomings:

- Although digitization made SA information accurate, sufficiently detailed, timely, and readily available, in many instances commanders chose to ignore it.
- Although digital technologies have great potential, they need improvement because :
  - ♦ Currently available computer technologies and applications are too complex for stressed, time-pressured, and infrequent users.
  - ♦ Lack of user-friendliness and poor soldier-machine interfaces discourage use of the technology in stressful situations.
  - ♦ Report procedures and other pre-formatted messages as currently implemented are essentially not used because they are too cumbersome.

- ♦ There is a lack of practical techniques for data input into the digital systems.

- Communications networks are unreliable and unstable. Some shortfalls noted are :
  - ♦ Current channel priority and precedence allocation schemes have been observed to give rise to data/voice contention on the communications networks.
  - ♦ Appliqué/Tactical Internet (TI) do not provide the messaging capabilities to support tactical operations. The current Appliqué/TI concept is inadequate for the anticipated needs and requirements.
  - ♦ In the same vein, there is a serious lack of connectivity, both vertical and horizontal, and of integration among and between digital systems currently on the battlefield. In particular, the interfaces between Army Tactical Command and Control Systems (ATCCS) and Appliqué/Tactical Internet were very limited, unreliable, and insufficient. All too often, Battlefield Operating Systems (BOS) do not achieve interconnectivity.
  - ♦ The lack of connectivity between digitized units and non-digitized units requires ad-hoc personnel-intensive procedures to ensure collection, processing, and dissemination of information . Thus there is a large increase in the requirement for "Swivel-chair" interfaces (liaisons) between systems.
  - ♦ Information exchange with non-digitized units is difficult.
- Digital Command and Control (C2) suffers from a lack of automated planning tools (including digital maps) and of wargaming simulation capabilities (for COA analysis, decision aids).
- Technological and multi-functional automation skills are lacking across the board. The soldiers and their leaders are not properly trained in the skills needed to get the best results from digital equipment.
- Tactics, Techniques, and Procedures (TTP) for digitized and partially digitized operations are inadequate.
- **Information proliferation on the battlefield complicates the decision making process**. Commanders must be able to process large amounts of information quickly in order to make timely tactical decisions. Commanders often spent a significant amount of time trying to interpret what they saw on their digital device screen rather than using their senses to command and control. In addition, the proliferation of information often increases staff workload substantially and the benefits of digitization can be negated if the information and equipment is not used correctly. The conclusion is that inefficient digital systems, their inefficient usage, and inadequate TTP or poor mastering of existing TTP often cause the **digital systems to become distracters rather than helpers**. This results in wasted time and in lost opportunities to exploit the advantages of digitization and dominate the battlefield.

## C) <u>Implications :</u>

- The Army must address the inadequacy of the training of its troops in combat fundamentals and the inadequacy of current training in digital technologies for troops and leaders.

- TTP for digital operations and for the integration of non-digitized forces with digitized forces need be developed.
- The Army must achieve commonality, standardization, or at the very least (seamless) connectivity among its information systems, especially between FBCB2 networks and ABCS (ATCSS) systems.
- Digital information systems need more functionality, vertical and horizontal linkages, and bandwidth. Digital information systems also need to be more user friendly and to be integrated with non-digitized systems.
- Digitized maps for all areas of the world are needed.

## III. Lessons Learned.

- AWEs must be designed to address specific and focused issues, not all the issues simultaneously.
- AWEs that were successful in collecting credible data were those that had limited scope and adhered to the stated and planned objectives.
- Conducting an AWE in conjunction with a training exercise introduces conflicts in exercise objectives.
- Sufficient time must be allocated between training events to allow soldiers to assimilate lessons learned during training and to repeat difficult aspects of training. The bottom line is that troops need be trained to standard not to schedule.
- Systems that are user friendly are used the most.
- Successful use of digitization and maintenance of the digital equipment require a highly trained force and highly qualified support personnel. These requirements also imply **sustained** training, as knowledge gained during training on digitized technologies has been observed to be very perishable.
- Digital C2 systems were not observed to decrease planning cycles, even though they allow for faster dissemination of information.
- Performance of specific initiatives and effectiveness effects are extremely hard to isolate, instead synergistic and cumulative effects are often observed. In all digitization AWEs conducted by the US Army to date, analysis of final results almost always showed some increase in performance and/or effectiveness of the forces. The observed effects, however, are always cumulative and synergistic in nature, and it is usually not possible to isolate any single factor (or initiative) that, **alone**, contributed to the observed effects. Thus, there is no conclusive evidence that increased performance and effectiveness can be attributed to digitization **alone**.
- In order to achieve tactical surprise and reduce fratricide, Situation Awareness must be available in **near-real time**.
- Most Subject Matter Experts (SMEs) observing the various AWE agree that digitization benefits will not be achieved until connectivity among and across the BOSs is achieved.
- Digital Command and Control requires a high level of integration.

- Digital message traffic usually increases as soldiers become more familiar with the systems, indicating an increased confidence in using the digital equipment.
- **Printed matter and large paper maps are still used extensively** by commander and staff for personal and collaborative use, even though large screen displays are available and do enhance SA. It appears that optimization of digital technologies will not change this trend and that the current idea of a "paperless" TOC must be discarded.
- **FM voice is still the preferred channel of communication** during combat or **during stressful situations**. Under stress, soldiers often become frustrated about delays and abandon digitized equipment and procedures, turning to voice radio because they feel this gets the job done more quickly. This leads to the conclusion that voice communications will not disappear from future digitized units.
- **Expect moderate force performance increases from digitization.** After multiple AWEs, it is evident that digitization will not result in twofold or threefold increases in performance and/or effectiveness. In some isolated "ideal" modeling cases, increases in force effectiveness of 150 % have been observed (Cf. Post-NTC TF XXI constructive modeling). These, however, are isolated instances, and on the average, increases in overall force effectiveness have been more modest. As such, military leaders and decision makers should be made aware that the potential enhancements afforded by digitization are more likely to be in the 20- 40 % range, with the caveat that this only happens if the advantages of digitization are properly exploited.

# IV. Remaining Issues and Challenges.

- Information-age technology not only increases training requirements on leaders and troops, but it also **requires a large number of experts** and **a diversity of expertise** to keep all systems operating and secure. The question persists as to who will be responsible for these tasks. Should the Army increase the number of signal officers to fill those roles? Is a contractor corps the way of the future?
- The idea that digitization will allow reduction of force structure warrants further investigation, as AWE results indicate that a **reorganization** of force structure is probably more appropriate than a **reduction** of force structure.
- The ability to command and control while on the move has not been demonstrated.
- It has been reported that, in order to achieve tactical surprise and reduce fratricide, situation awareness must incorporate **all friendly elements within a unit's area of influence**. What is the "area of influence" of a particular unit under digitized operations? How much SA is required to make a noticeable, **positive**, impact? Is absolute SA required? Is the commonly assumed rule of thumb "two echelons up and two echelons down" adequate? This needs more looking into.
- There is currently no handle on the question of who should get what. In other words, no one has figured out yet what "the" appropriate distribution and

allocation scheme for digital equipment and information should be. Further studies are needed.

- Even though modeling has shown the great potential of digitization "when all the right conditions" occur to be realized, it remains to be demonstrated that these conditions will ever materialize on the battlefield. In particular, if commanders do not change their attitudes, digitization will not yield the expected benefits. (Cf. TF XXI numerous missed opportunities)
- Maintenance and management of digitized networks are of critical importance. This is a serious challenge.
- Connectivity within and between networks, connectivity between FBCB2 and ATCCS (and ABCS), and integration of non-digitized units with digitized units also remain pressing challenges.

## V. Conclusion

The latest AWEs (TFXXI, Division XXI), which reflect the most current performance of digital technologies, have shown that digital are steadily improving, albeit more slowly than one would like

Though connectivity across networks and across BOS remains one of the most compelling challenges, it is anticipated that once the digital systems and TTPs become fully mature, digitization will have a **positive** impact on force effectiveness. This is amply supported by modeling and simulation, which have demonstrated time and again that, when the opportunities afforded by digitization are capitalized upon, a digitized force performs at least as well as and, in most cases, substantially better than a comparable non-digitized force.

**Annex D**

**United Kingdom National Input**

**To be provided in 2nd edition.**

**Annex E**

**Canadian National Input**

**To be provided in 2nd edition.**

**Annex F**

**Australian National Input**

**Battlefield Command Support System (BCSS)**

## BACKGROUND

The Australian army digitization efforts are ongoing. This annex describes the test that are planned and the 2nd edition of this QAP will include results from those tests.

The Australian Army Command Support System (AUSTACSS) has been the major acquisition project providing automated command support systems to the Land Force. The early Phases of AUSTACSS, through the 1970's and 1980's, developed detailed user requirements and specifications. Phase 3.1 of AUSTACSS aimed to field an Initial Basic System (IBS) and a contract to deliver this capability was signed in November 1992.

Development of the final Build 5 of the IBS software was be complete in April 1998. The IBS, including a minimum level of hardware, will be used during the 1998 RTA trials and will provide 1st Task Force (1TF) with a higher level of understanding of implementing automated command support systems.

The later Phases of AUSTACSS have been renamed the Battlefield Command Support System (BCSS). The Capability Forum approved BCSS Phase 3.2 on 25 Sep 97. BCSS Phase 3.2 aims to introduce NT Windows as the BCSS operating system, complete the equipping of 1TF and provide additional software functionality and Integrated Logistics Support (ILS). Phases 3.3 and 3.4 will equip the remainder of the Land Force and appropriate training establishments and continue to provide additional software functionality and ILS.

## OBJECTIVES

The objectives for BCSS Phase 3.2 are, in priority order, to:

1. provide 1TF a command support system which can substantially improve combat capability through the application of Information Technology to the battlefield;
2. provide 1TF with a command support system which will decrease decision action cycles at all levels by reducing knowledge to decision time frames and sensor to shooter time frames;
3. provide 1TF with the capability to improve the quality of decisions;
4. provide 1TF with a command support system which provides the highest quality of battlefield situation awareness through the delivery and appropriate presentation of strategic, operational and tactical location and sensor information
5. provide 1TF with a command support system which has high levels of technical, operational and procedural interoperability with other command support system projects, in particular JCSE at HQ NORCOM, leading towards an ADF joint Common Operating Environment

(COE) and also appropriate levels of interoperability with allied command support systems, in particular, the United States Marine Corps;

6. provide 1TF with a command support system which allows capture of critical operational data at source and appropriately automates collation and presentation at every level of command;
7. provide 1TF with a command support system which allows for the flexible redesign and implementation of headquarters processes and procedures in order to maximize combat capability and minimize administrative and office overheads at all levels;
8. implement an acquisition and development approach which supports rapid evolution of the user requirement and delivers functionality through collaborative development between the user and contractor;
9. utilize "market leader" COTS hardware and software components which maximizes the re-use of applications developed through other command support systems, maintains flexibility and future enhancement potential and minimizes capital costs, training and ILS overheads;
10. deliver the first release of operational software in a Windows NT environment by 30 March 1999;
11. develop an ILS plan which caters for a rapidly evolving hardware and software environment and provides appropriate support infrastructure for Phase 3.2 and future phases; and,
12. develop the high level specifications and prototypes for specialist command support sub-systems to be developed in Phases 3.3 and 3.4

**SCOPE**

**Inclusions**

1. BCSS will provide command support systems to 1TF headquarters from formation to platoon headquarters level and to platform level where appropriate.
2. BCSS includes the provision of hardware and software for use in-barracks and in the field.
3. BCSS includes the provision of scalable hardware devices with defined or limited functionality for use as field lightweight data devices capable of facilitating sensor to shooter information transfer.
4. BCSS includes the software development and integration of the Intelligence Command Support System (ICSS) and the Engineering Command Support System (ECSS) (but not the 1998 prototyping funded through Army minors).
5. BCSS includes the minimum appropriate level of security and robustness required for the tactical environment.

**Exclusions**

1. BCSS will not develop or procure battlefield or strategic communications bearer systems for the transfer of digital information to or between BCSS information nodes;

2. BCSS will generally not provide funds for in-barracks network connectivity (which should be provided through BAN/LAN projects and the Defence Backbone Router System (BRS);
3. BCSS will not procure or provide digital topographic information or Military Geographic Information (MGI) which may be required for electronic map displays (funds may be provided to prepare this data for loading into the BCSS);
4. The BCSS system architecture will not provide or be designed for a Multilevel Security (MLS) security environment (MLS will be adopted in due course when commercially available or through Defence MLS projects);
5. BCSS is not scoped to include significant costs related to physical security of in-barracks SECRET high components

## TECHNICAL PRODUCTS

### Architecture

BCSS Phase 3.2 aims to adopt a flexible architecture that will allow for changes in 1TF structure, organisation, doctrine and technology. The RTA trials process is a method for doctrine led change to the way the Australian Army fights battles. The command support system provided by BCSS Phase 3.2 enables such change and must be able to adapt to changes in structure, organisation and doctrine as they occur. The principal specialist technical products relating to architecture are as follows:

### Hardware Products

Hardware will be generally INTEL based and will be COTS. Initial definition of hardware components will be completed during system architecture and hardware studies, however it can be expected that hardware requirements will change as new commercial products become available. 1TF will be provisioned with equipment, supplemented by existing equipment, to the TF headquarters and all subordinate units, with a mixture of cheaper (than AUSTACSS 3.1) commercial grade desktop and field computers. The field equipment will form a sub-set of the barracks equipment that is removed upon deployment but will allow barracks and field networks to operate concurrently. Hand held terminals are to be provisioned down to platoon headquarters level, and to platform level where appropriate, across the Task Force.

### Software Products

Software development is to adopt a rapid evolutionary development approach with operational software aiming to be released at approximately six monthly intervals in March and September each year (from March 1999). Within each six month cycle there will be at least two prototype development cycles where additional functionality will be developed and released as "Beta" versions to Prototype Evaluation Facilities (PEFs) at 1TF, the School of Signals, DSTO and the PSI's development site. Every prototype cycle will include "Joint Application Development" workshops where potential tools will be demonstrated to the user and user development priorities will be confirmed. Integration of COTS products must be flexible enough to facilitate later changes to COTS products (even if this flexibility may limit functionality in the shorter term). The

highest priority for software development is migration to Windows NT, taking advantage of cheaper hardware platforms. Other development will be informed by user feedback, but is initially aimed at:

**Communications**. The BCSS will be required to support communications interfaces to other systems, including but not limited to:

ACP127/128 formal messages and connectivity to DISCON. ACP123, when it is commercially available in Lotus Notes DMS or implemented as part of the Defence Message and Directory Environment (DMDE). Lotus Notes e-mail. Internet (via RESTR/UNCLAS Defence gateways) and secure intranets (SECRET), dependent on the level of system high networking. Database information exchange utilizing Lotus Notes (may be constrained by bandwidth limitations when deployed). Combat Net Radio and mobile SATCOM bearer systems.

**Battlefield Visualization and Situation Awareness**. This will include the capture of appropriate data at source, distribution of information through formatted messages over tactical networks, automated collation and graphical presentation of data at all levels. Information should be able to be displayed in two, three and four (time) dimensional perspective views. This includes the ability to roam across the depicted battle space in real time with any information type, or combination thereof, being displayed.

**Collaborative Planning Tools.** Facilitates simultaneous staff input into tactical/operational appreciations, plans and orders. Much of this development may be facilitated through Lotus Notes database and workflow applications.

**Intelligence Command Support Sub-System (ICSS).** ICSS automates components of the intelligence staff process to enable the rapid capture, processing and transfer of intelligence data. Development and integration of ICSS will commence in 1999 following prototype trials in 1998.

**Engineer Command Support Sub-System (ECSS).** ECSS supports engineer commanders and staff in the planning and execution of engineer missions. Development and integration of ECSS will commence in 1999 following prototype trials in 1998.

**Simulation Tools.** Simulation tools should be provided to facilitate war gaming that will allow development of a range of courses of action for battlefield plans in training and operations.

**Combined Voice/Data/Videoconferencing Services.** The BCSS terminals should incorporate a voice interface to reduce the amount of cabling and hardware in individual command posts. Videoconferencing services may be added in due course.

**Core Operational Staff Tools.** The BCSS will provide core operational staff tools in the priority determined by the user.

**Compression Algorithms.** Development or adoption of appropriate compression algorithms may allow more efficient use of the communications bandwidths that may be available to the 1TF headquarters.

**RELATED INITIATIVES**

1. **BCSS Phase 3.3 (YOD00/01).** This Phase follows on from BCSS Phase 3.2 and will equip the Special Operations Group (SOG), up to two RTA Task Forces and Army Training Establishments. It will also include further enhancements to software functionality.
2. **BCSS Phase 3.4 (YOD01/02).** This Phase will equip the remaining RTA Task Forces and establish Regional Training and Mobilization Centres (RTMC). Software functionality development will be completed.
3. **Joint Command Support Environment (JCSE).** The JCSE provides the command support systems for almost every superior headquarters of Land Force formations and direct command units. BCSS must have high levels of technical, operational and procedural interoperability and commonality with JCSE. BCSS will reuse relevant applications developed under JCSE wherever possible.
4. **Joint Intelligence Support Environment (JISE).** JISE intelligence information will be utilized at SECRET level as part of the BCSS situation awareness pictures. BCSS and ICSS may reuse relevant applications developed under JISE.
5. **Australian Defence Force Messaging System (ADFORMS).** ADFORMS is the principal ADF mechanism for passing structured data between information nodes and command support systems.
6. **Intelligence Command Support System (ICSS).** The ICSS provides specialist intelligence tools and is being built as a prototype during 1998. It will be fully developed and integrated into the BCSS during 1999.
7. **Engineering Command Support System (ECSS)**. The ECSS provides specialist engineering tools and is being built as a prototype during 1998. It will be fully developed and integrated into the BCSS during 1999.
8. **Project PARAKEET.** Project PARAKEET provides secure wide band multi-channel data and voice communications bearers (via satellite and radio relay) between deployed information nodes of BCSS and between deployed information nodes of BCSS and JCSE/JISE.
9. **Projects RAVEN, WAGTAIL and PINTAIL**. Projects RAVEN, WAGTAIL and PINTAIL provide secure and insecure narrow band single channel broadcast HF/VHF radio network communications between deployed information nodes of BCSS. These are the principal method of voice and data communications below Task Force Headquarters level.
10. **Defence Communications Projects**. The Defence MILSATCOM projects provide space segment communications bearers for Project PARAKEET. They also propose to provide mobile narrow band single channel ground stations to supplement terrestrial radio communications bearers (RAVEN etc.). The Defence HF Modernization projects will provide strategic HF communications interfaces with tactical radio systems.
11. **Army Mobility Projects.** A number of Army mobility projects are providing enhanced armoured reconnaissance and infantry mobility. These platforms will need to be considered as part of the Platform Integration Program.

12. **Project WUNDARRA**. Project WUNDURRA will improve the integrated battlefield sensor and situation awareness capability available to the individual soldier. BCSS will need to handle information provided to and from the WUNDURRA systems.

13. **Project NINOX.** Project NINOX will improve the battlefield sensor systems available to soldiers and mobile platforms. BCSS will need to accept, display and manipulate both raw data (e.g. imagery) and processed information from these sensor systems.

14. **Defence/Allied Wide Area Surveillance and Airborne Reconnaissance Projects.** Defence Wide Area Surveillance and airborne reconnaissance projects (e.g. JP129) will introduce sensor and observation platforms for use at strategic, operational and tactical levels. BCSS will need to accept, display and manipulate both raw data (e.g. imagery) and processed information from these sensor systems. BCSS will also need to accept and display situation awareness information provided through allied satellite broadcast channels.

**TIMING**

Outline timings for BCSS Phase 3.2 are:

| | |
|---|---|
| Sep 97 | Capability Forum Endorsement |
| Nov 97 | Budget approval |
| Mar 98 | Contracts in place for initial architectural and process studies |
| Jun 98 | PSI contract in place |
| Jul 98 | Prototype Evaluation Facilities and development site established |
| Jul/Aug 98 | Studies complete / evolutionary development cycles begin |
| Aug 98 | Long lead time hardware ordered |
| Nov 98 | NT environment introduced to 1TF |
| Mar 99 | 1st release of operational software delivered |
| Mar 99 | Most hardware delivered |
| Sep 99 | 2nd release of operational software delivered |
| Mar 00 | 3rd release of operational software delivered |
| Jun 00 | 1TF operational capability complete |